US009211118B2

(12) **United States Patent**
Gregoire et al.

(10) **Patent No.: US 9,211,118 B2**
(45) **Date of Patent: Dec. 15, 2015**

(54) **SUTURE PASSER**

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(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 1301 days.

(21) Appl. No.: **12/619,124**

(22) Filed: **Nov. 16, 2009**

(65) **Prior Publication Data**

US 2011/0118760 A1 May 19, 2011

(51) **Int. Cl.**

A61B 17/58	(2006.01)
A61B 17/04	(2006.01)
A61B 17/29	(2006.01)
A61B 17/06	(2006.01)

(52) **U.S. Cl.**

CPC ***A61B 17/0483*** (2013.01); *A61B 17/29* (2013.01); *A61B 2017/06042* (2013.01)

(58) **Field of Classification Search**

CPC A61B 17/0625; A61B 17/29; A61B 17/0483; A61B 17/0469

USPC 606/139–145, 224

See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

919,138	A	4/1909	Drake et al.	606/144
1,635,066	A	7/1927	Wells	606/145
2,269,963	A	1/1942	Wappler	604/61
2,286,578	A	6/1942	Sauter	606/148
2,327,353	A	8/1943	Karle	606/146
2,737,954	A	3/1956	Knapp	606/146
2,738,790	A	3/1956	Todt, Sr. et al.	606/145
3,842,840	A *	10/1974	Schweizer	606/145
3,946,740	A	3/1976	Bassett	128/334
4,027,608	A	6/1977	Arbuckle	112/169
4,109,658	A	8/1978	Hughes	128/340
4,164,225	A	8/1979	Johnson	128/334
4,235,177	A	11/1980	Arbuckle	112/169
4,345,601	A	8/1982	Fukuda	128/339
4,373,530	A	2/1983	Kilejian	128/334 R
4,484,580	A	11/1984	Nomoto et al.	606/146
4,493,323	A	1/1985	Albright et al.	128/340

(Continued)

FOREIGN PATENT DOCUMENTS

CA	2205176	12/2000	A61B 17/04
DE	4235602 A1	4/1994	A61B 17/04

(Continued)

OTHER PUBLICATIONS

PCT International Search Report for PCT/US01/42186 3 pgs.

(Continued)

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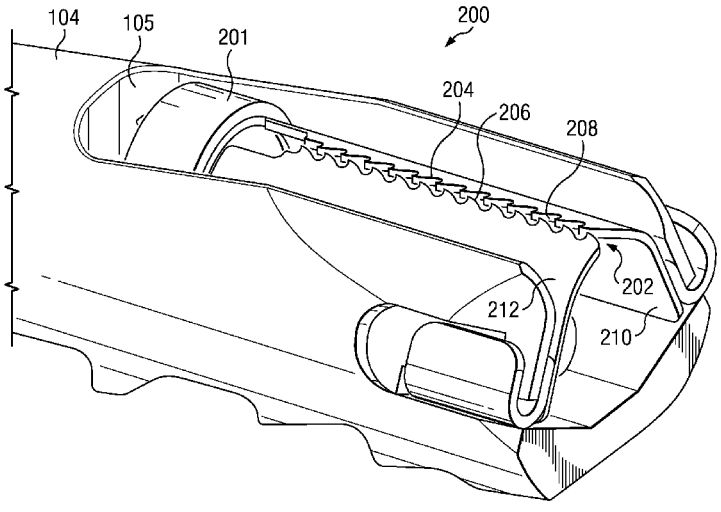
(57) **ABSTRACT**

A suturing device for grasping soft tissue and placing stitches in soft tissue during endoscopic procedures is described. An elongate housing with a stationary jaw and a movable jaw disposed at the distal end are configured for grasping and releasing soft tissue. A movable needle disposed within the housing is actuated to engage a length of suture and drive the suture into and through the grasped soft tissue. A suture capture member is disposed on the movable jaw and is configured to allow passage of the needle therethrough while securing a portion of the stitched length of suture.

37 Claims, 7 Drawing Sheets



(56) **References Cited**

U.S. PATENT DOCUMENTS

4,621,640	A	11/1986	Mulhollan et al.	128/340
4,635,637	A	1/1987	Schreiber	128/337
4,738,255	A	4/1988	Goble et al.	128/92 YF
4,741,330	A	5/1988	Hayhurst	128/43 R
4,781,182	A	11/1988	Purnell et al.	128/92
4,836,205	A	6/1989	Barrett	128/340
4,923,461	A	5/1990	Caspari	606/146
4,926,860	A	5/1990	Stice et al.	606/146
4,935,027	A	6/1990	Yoon	606/146
4,957,498	A	9/1990	Caspari	606/146
4,981,149	A	1/1991	Yoon et al.	128/898
5,037,422	A	8/1991	Hayhurst et al.	606/72
5,037,433	A	8/1991	Wilk et al.	606/139
5,046,513	A	9/1991	Gatturna et al.	128/898
5,059,201	A	10/1991	Asnis	606/144
5,085,661	A	2/1992	Moss	606/139
5,152,769	A	10/1992	Baber	606/145
5,217,471	A	6/1993	Burkhart	606/148
5,222,977	A	6/1993	Esser	606/223
5,269,786	A	12/1993	Morgan	606/96
5,304,184	A	4/1994	Hathaway et al.	606/144
5,312,422	A	5/1994	Trott	606/144
5,318,577	A	6/1994	Li	606/147
5,336,229	A	8/1994	Noda	606/144
5,356,424	A	10/1994	Buzerak et al.	606/223
5,397,325	A	3/1995	Della Badia et al.	112/169
5,403,329	A	4/1995	Hinchcliffe	606/147
5,409,494	A	4/1995	Morgan	606/96
5,417,699	A	5/1995	Klein et al.	606/139
5,431,666	A	7/1995	Sauer et al.	606/139
5,445,167	A	8/1995	Yoon et al.	128/898
5,454,823	A	10/1995	Richardson et al.	606/148
5,474,565	A	12/1995	Trott	606/144
5,480,405	A	1/1996	Yoon	606/139
5,499,991	A	3/1996	Garman et al.	606/148
5,501,688	A	3/1996	Whiteside et al.	606/103
5,522,820	A	6/1996	Caspari et al.	606/148
5,527,322	A	6/1996	Klein et al.	606/144
5,540,705	A	7/1996	Meade et al.	606/145
5,573,542	A	11/1996	Stevens	606/144
5,575,801	A	11/1996	Habermeyer et al.	606/144
5,609,597	A	3/1997	Lehrer	606/139
5,613,974	A	3/1997	Andreas et al.	606/144
5,618,290	A	4/1997	Toy et al.	606/139
5,626,590	A	5/1997	Wilk	606/148
5,645,552	A	7/1997	Sherts	606/145
5,653,717	A	8/1997	Ko et al.	606/144
5,665,108	A	9/1997	Galindo	606/215
5,690,653	A	11/1997	Richardson et al.	606/148
5,700,273	A	12/1997	Buelna et al.	606/148
5,741,281	A	4/1998	Martin	606/148
5,776,150	A	7/1998	Nolan et al.	606/148
5,779,719	A	7/1998	Klein et al.	606/144
5,792,151	A	8/1998	Heck et al.	606/144
5,792,152	A	8/1998	Klein et al.	606/144
5,792,153	A	8/1998	Swain et al.	606/144
5,797,927	A	8/1998	Yoon	606/144
5,836,956	A	11/1998	Buelna et al.	606/148
5,860,991	A	1/1999	Klein et al.	606/145
5,860,992	A	1/1999	Daniel et al.	606/145
5,902,311	A	5/1999	Andreas et al.	606/144
5,904,692	A	5/1999	Steckel et al.	606/139
5,908,426	A	6/1999	Pierce	606/139
5,921,994	A	7/1999	Andreas et al.	606/144
5,947,982	A *	9/1999	Duran	606/139
5,954,733	A	9/1999	Yoon	606/147
5,957,937	A	9/1999	Yoon	606/147
5,980,538	A	11/1999	Fuchs et al.	606/145
5,984,933	A	11/1999	Yoon	606/148
6,001,109	A	12/1999	Kontos	606/148
6,022,360	A	2/2000	Reimels et al.	606/144
6,024,747	A	2/2000	Kontos	606/144
6,036,699	A	3/2000	Andreas et al.	606/139
6,048,351	A	4/2000	Gordon et al.	606/144
6,051,006	A	4/2000	Shluzas et al.	606/148
6,059,801	A	5/2000	Samimi	606/148
6,096,051	A	8/2000	Kortenbach et al.	606/144
6,117,144	A	9/2000	Nobles et al.	606/144
6,136,010	A	10/2000	Modesitt et al.	606/144
6,143,004	A	11/2000	Davis et al.	606/144
6,143,005	A	11/2000	Yoon et al.	606/148
6,214,028	B1	4/2001	Yoon et al.	606/205
6,217,592	B1	4/2001	Freda et al.	606/145
6,245,079	B1	6/2001	Nobles et al.	606/144
6,332,889	B1	12/2001	Sancoff et al.	606/148
6,533,795	B1	3/2003	Tran et al.	606/144
6,551,330	B1	4/2003	Bain et al.	606/144
6,605,096	B1	8/2003	Ritchart	606/144
6,770,084	B1	8/2004	Bain et al.	606/144
6,893,448	B2	5/2005	O'Quinn et al.	606/139
6,896,686	B2	5/2005	Weber	606/145
6,911,034	B2	6/2005	Nobles et al.	606/144
6,923,819	B2	8/2005	Meade et al.	606/144
6,984,237	B2	1/2006	Hatch et al.	606/139
7,004,951	B2	2/2006	Gibbens, III	606/144
7,090,686	B2	8/2006	Nobles et al.	606/144
7,112,208	B2	9/2006	Morris et al.	606/144
7,160,309	B2	1/2007	Voss	606/144
7,169,157	B2	1/2007	Kayan	606/148
7,198,631	B2	4/2007	Kanner et al.	606/139
7,377,926	B2	5/2008	Topper et al.	606/144
7,449,024	B2	11/2008	Stafford	606/144
7,544,199	B2	6/2009	Bain et al.	606/144
7,585,305	B2	9/2009	Dreyfuss	606/144
7,666,195	B2	2/2010	Kelleher et al.	606/144
7,758,597	B1 *	7/2010	Tran et al.	606/144
7,879,048	B2	2/2011	Bain et al.	606/144
8,147,505	B2	4/2012	Delli-Santi	606/144
8,562,629	B2	10/2013	Bain et al.	606/144
2002/0077649	A1 *	6/2002	Lasner	606/174
2002/0116011	A1 *	8/2002	Chee Chung et al.	606/145
2002/0147456	A1	10/2002	Diduch et al.	606/144
2003/0065337	A1 *	4/2003	Topper et al.	606/144
2003/0195528	A1	10/2003	Ritchart	606/144
2003/0233106	A1	12/2003	Dreyfuss	606/144
2004/0010273	A1	1/2004	Diduch et al.	606/144
2004/0236353	A1	11/2004	Bain et al.	606/139
2004/0249394	A1 *	12/2004	Morris et al.	606/144
2005/0165419	A1	7/2005	Sauer et al.	606/148
2008/0097482	A1	4/2008	Bain et al.	606/144

FOREIGN PATENT DOCUMENTS

DE	2532242 A1	7/1995	A61B 17/06
EP	0535906 A2	4/1993	A61B 17/04
EP	1408849 B1	12/2010	A61B 17/04
WO	91/06247	5/1991	A61B 17/00
WO	97/10756	3/1997	A61B 17/04
WO	03/028532	4/2003	A61B 17/04
WO	2010/111176	9/2010	A61B 17/04

OTHER PUBLICATIONS

PCT International Preliminary Examination Report for PCT/US01/42186 3pgs.
PCT International Search Report for PCT/US02/22889 2 pgs.
PCT International Preliminary Examination Report for PCT/US02/22889 3pgs.
PCT International Search Report for PCT/US03/18540 1 pg.
PCT International Preliminary Examination Report for PCT/US03/18540 4pgs.
European Search Report for EP 02752446 5pgs.
European Examination Report for EP 037419405 4pgs.
UK Search Report for GB 1019353.0 4pgs.

* cited by examiner

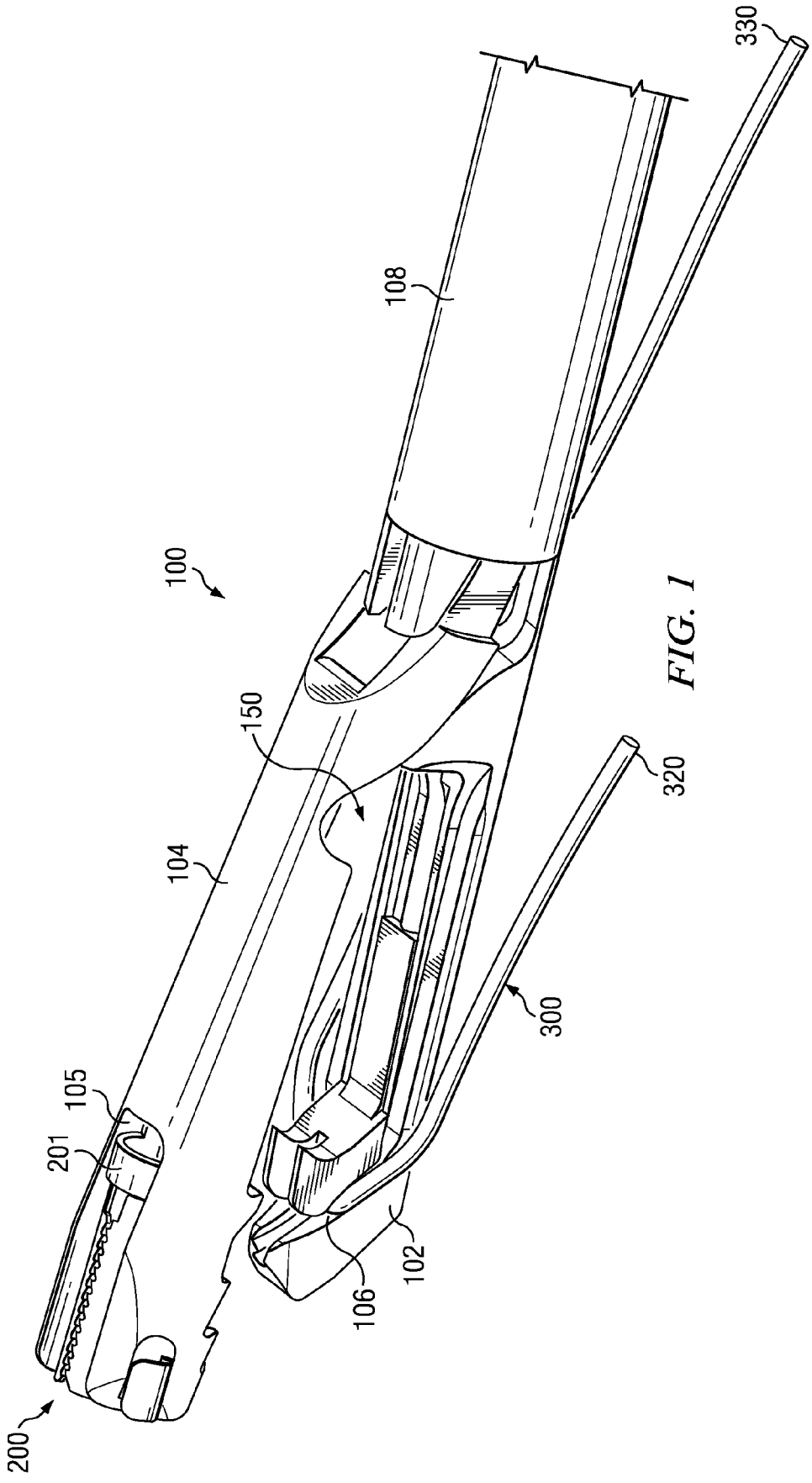


FIG. 1

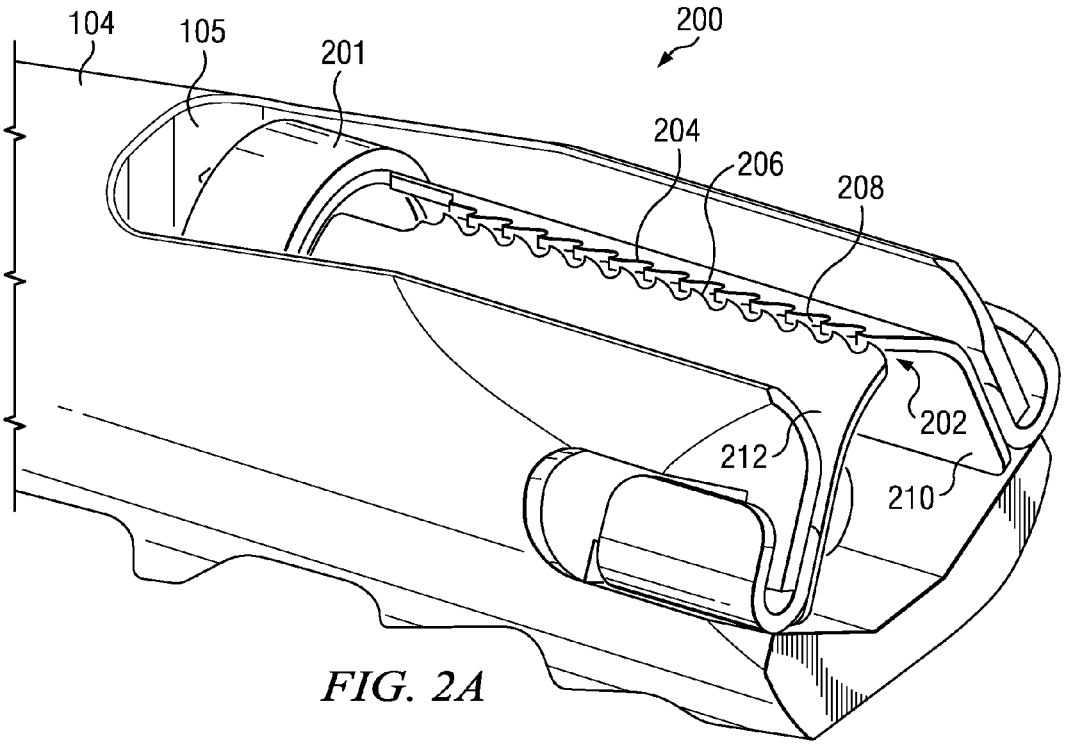

104
105
201
200
204
206
208
202
212
210

FIG. 2A

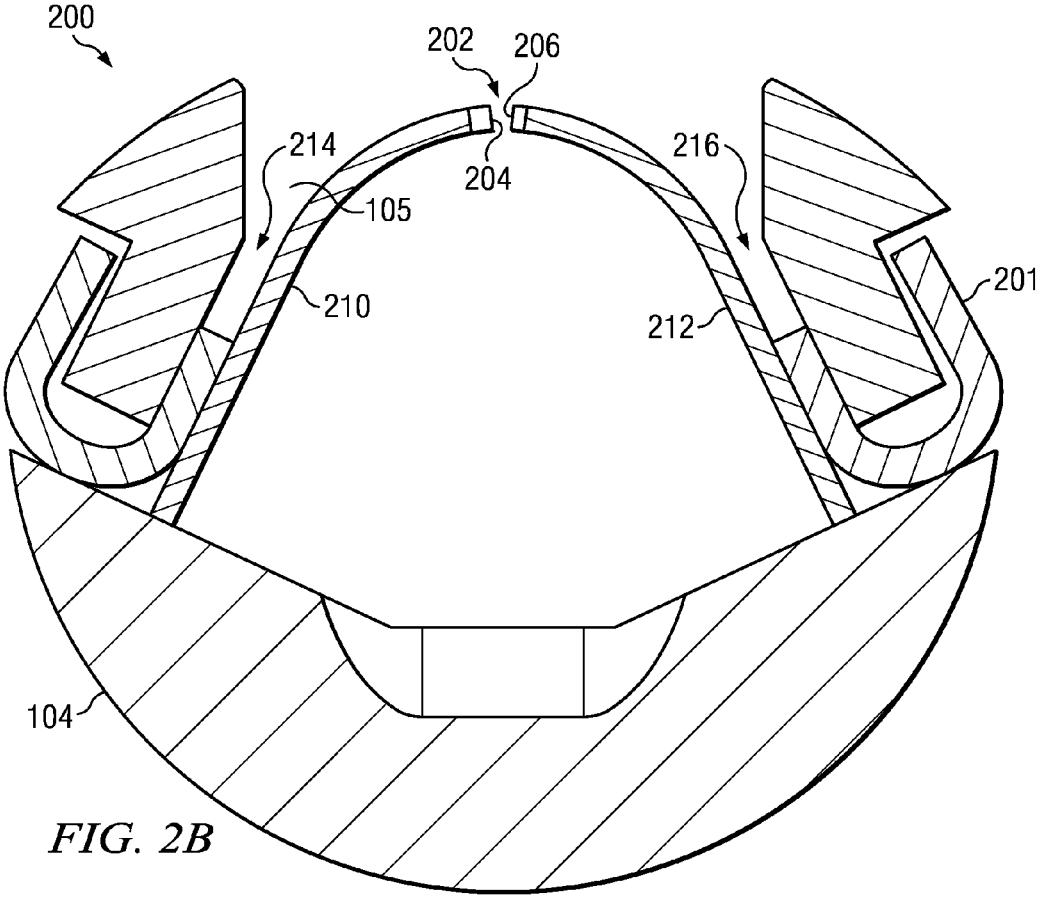

200
202
206
214
204
216
105
210
212
201
104

FIG. 2B

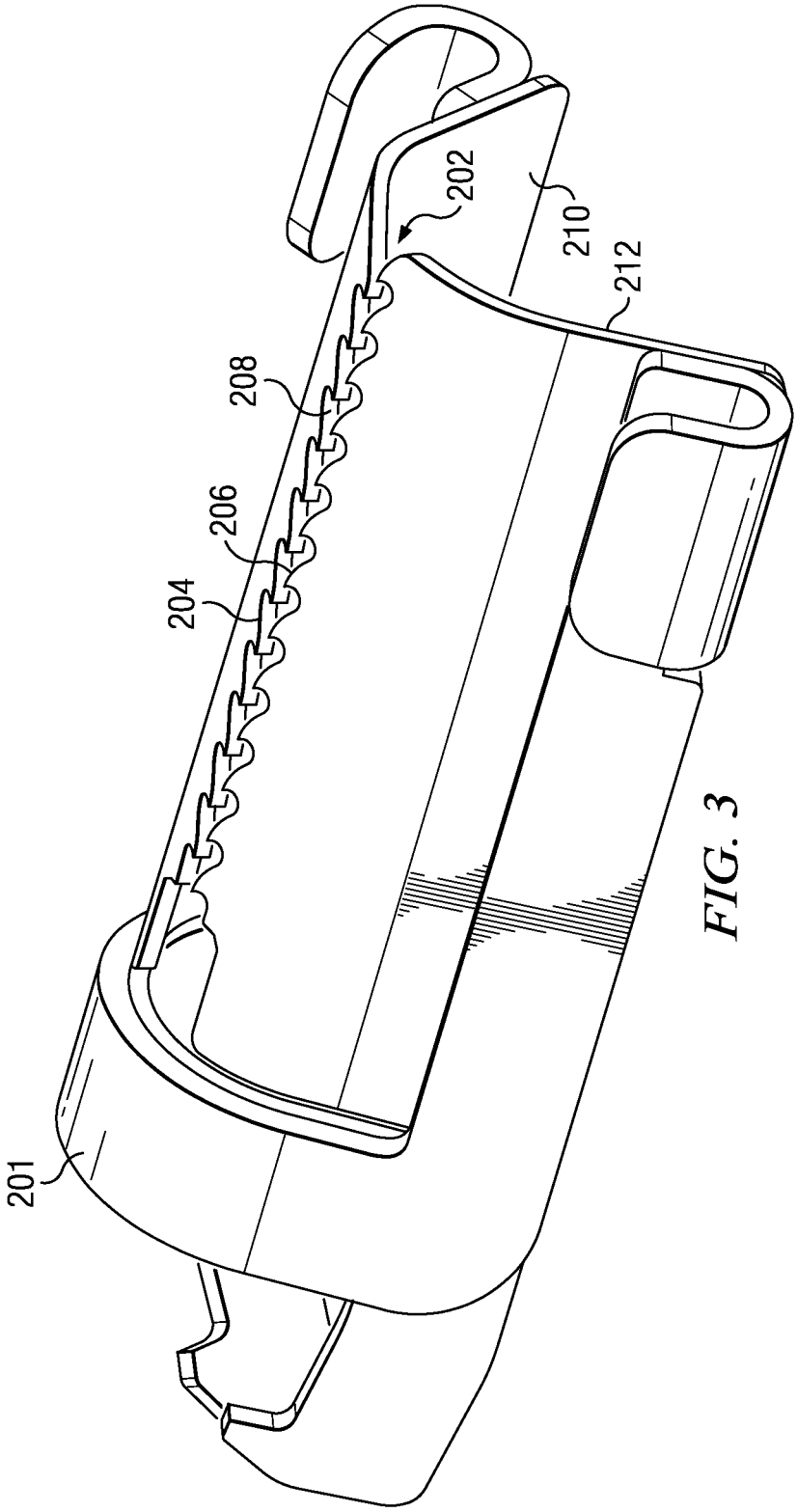


FIG. 3

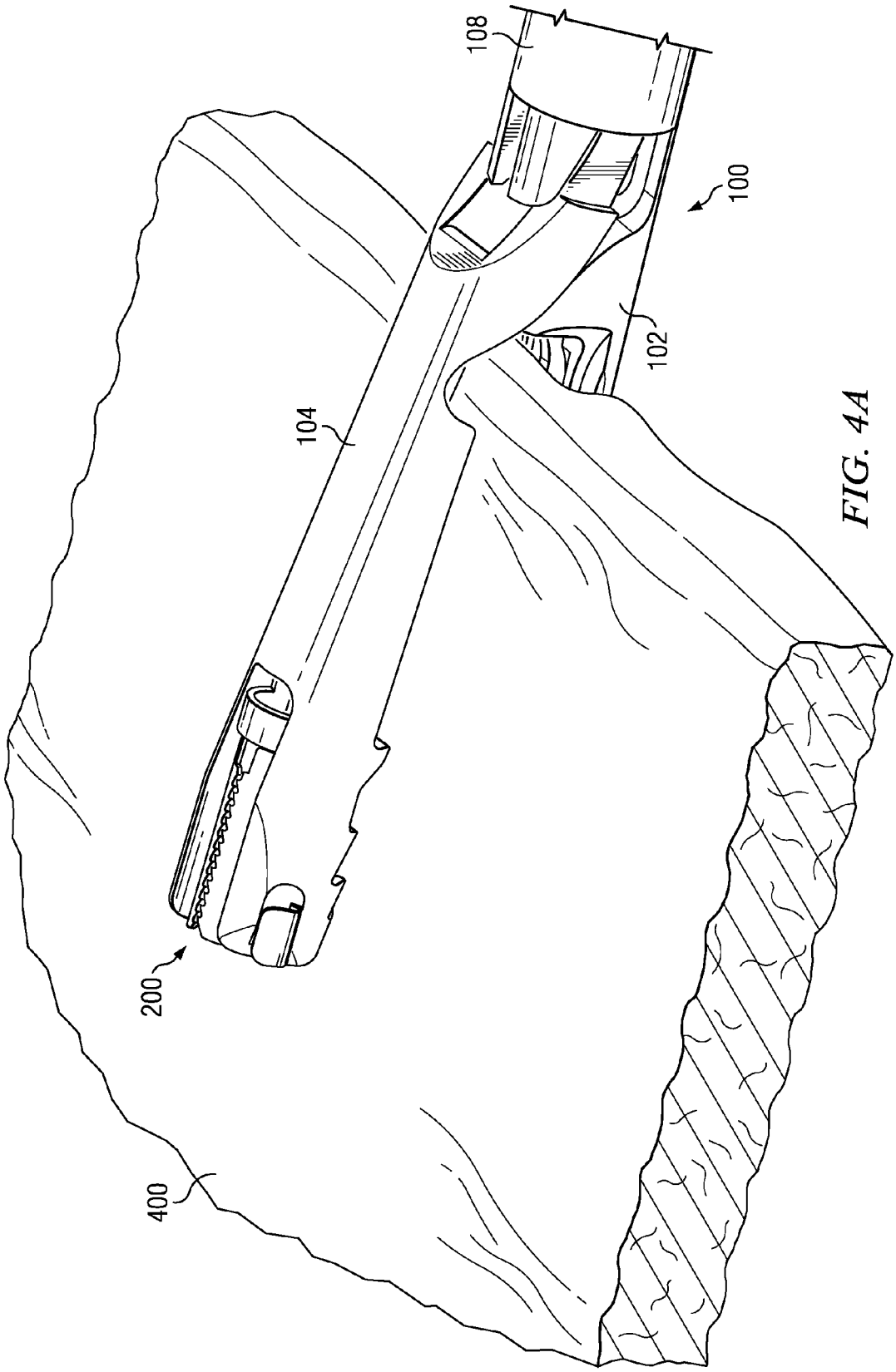
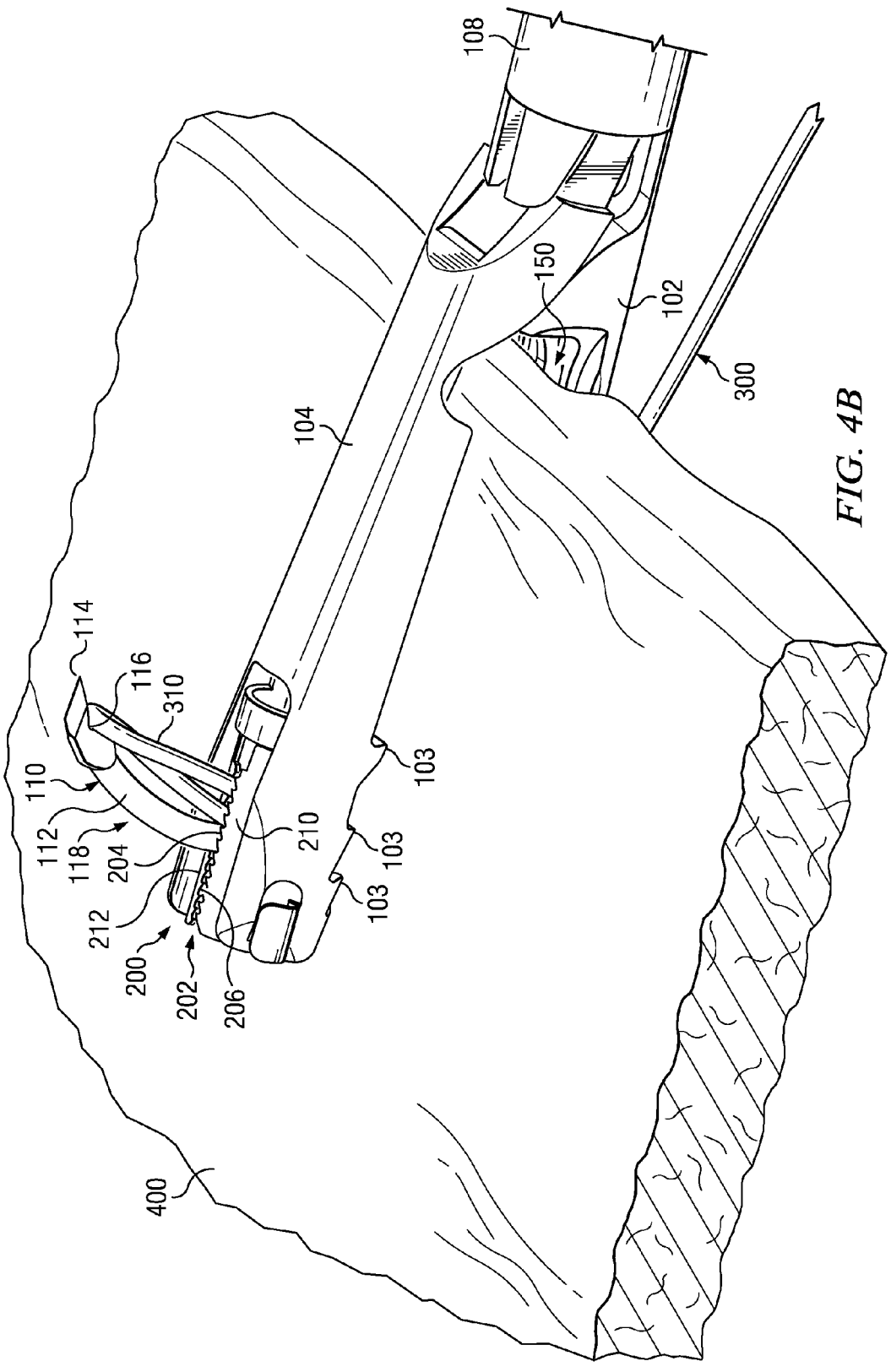


FIG. 4A


108
150
102
300
104
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212
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202
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103
103
400

FIG. 4B

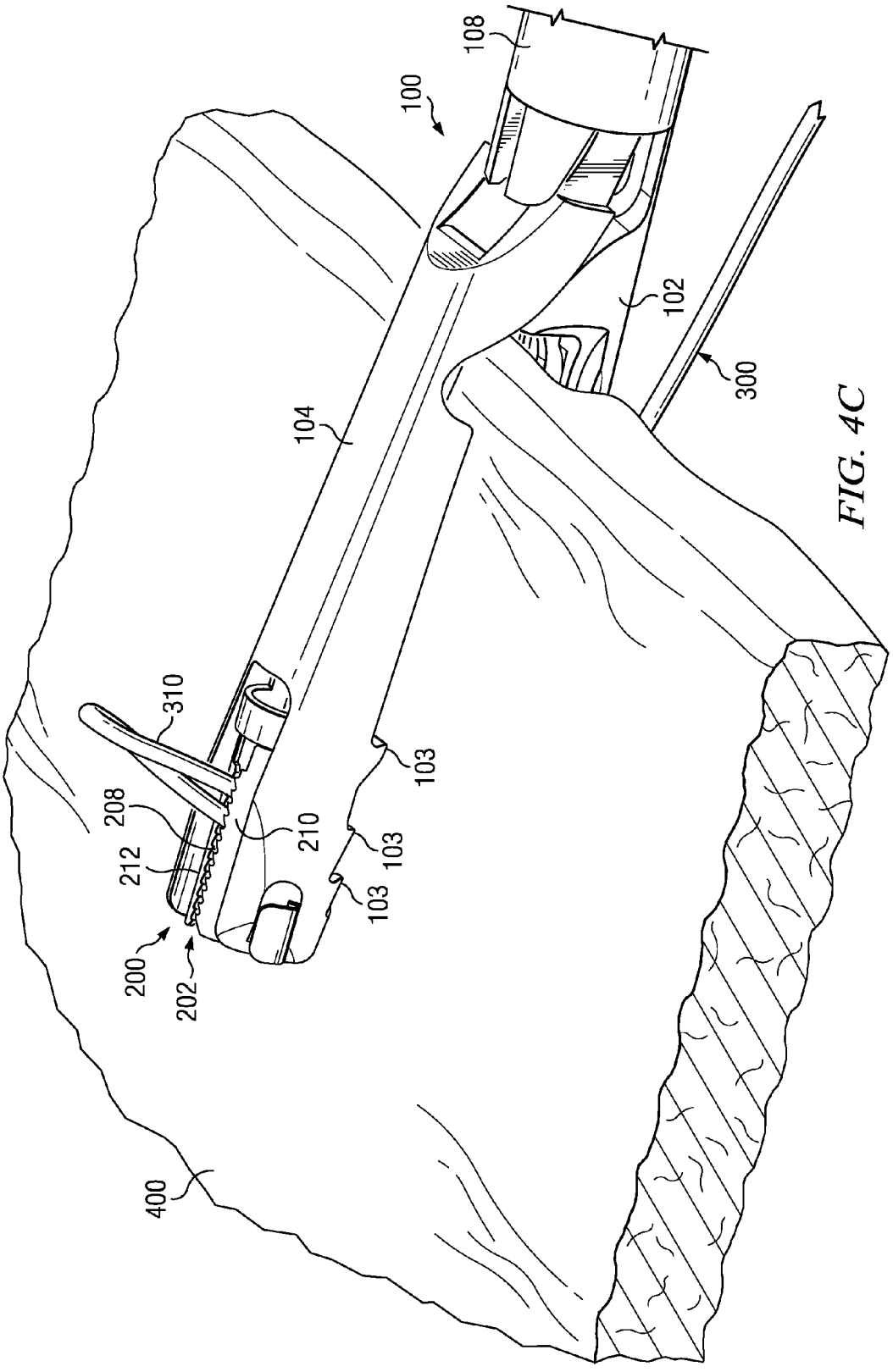

FIG. 4C

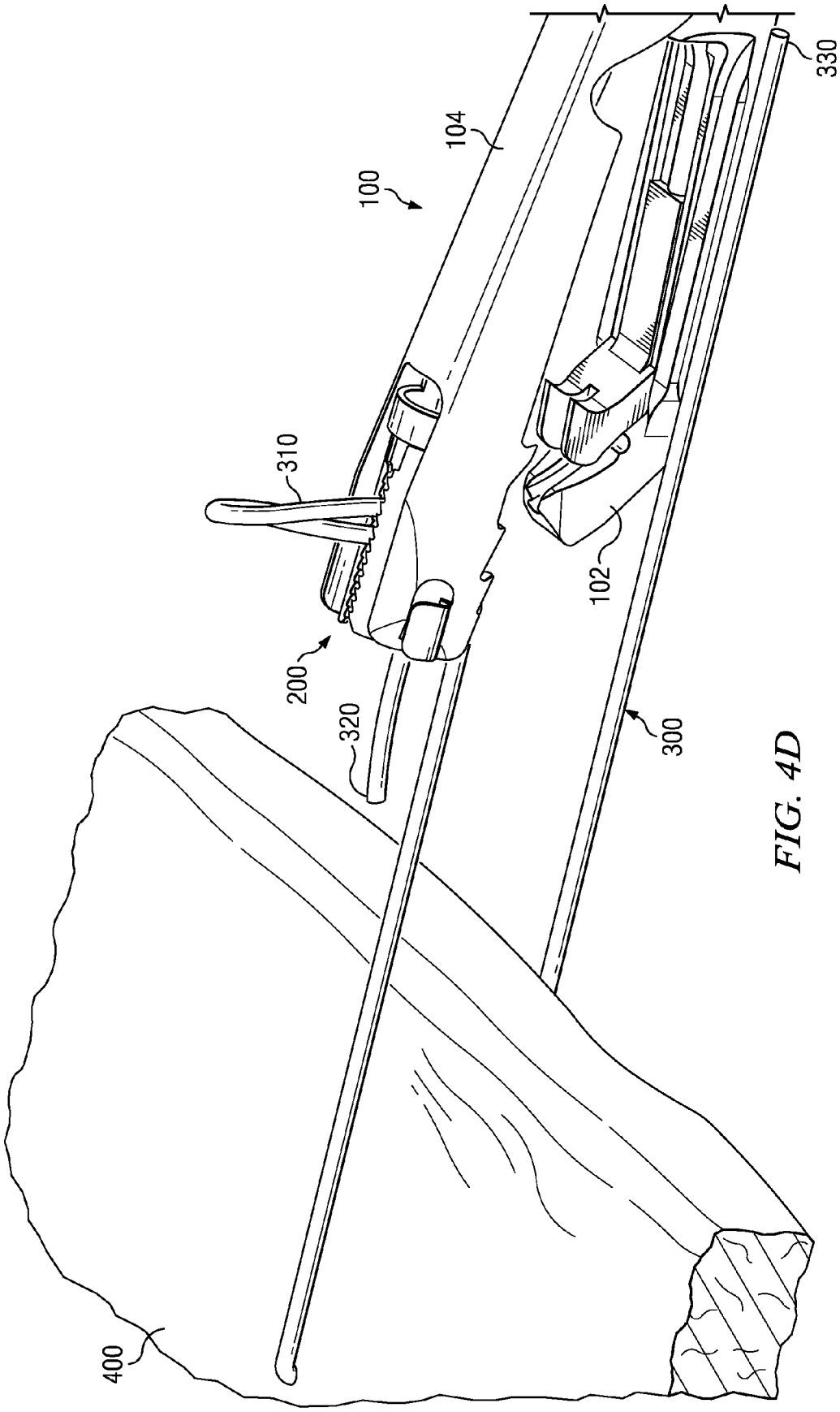

FIG. 4D

SUTURE PASSER

FIELD OF THE DISCLOSURE

The present invention relates to a method and apparatus for placing sutures in soft tissue. More particularly, the present invention relates to apparatus and methods improve the ability to place a stitch or suture deeper within tissue when compared to conventional methods. Although methods and devices described herein make reference to arthroscopic repair of torn rotator cuffs, the principles of the devices and methods may be applied to any soft tissue application.

BACKGROUND

Traditional suturing of body tissues is a time consuming aspect of most surgical procedures. Many surgical procedures are currently being performed where it is necessary to make a large opening to expose the area of, for instance, the human body that requires surgical repair. In recent practice, endoscopes are used to allow the viewing of certain areas of the body through a small puncture wound without exposing the entire body cavity. Endoscopes can be used in conjunction with specialized surgical instrumentation to detect, diagnose, and repair areas of the body that were previously only able to be repaired using traditional "open" surgery. In conjunction with the advances in endoscopic surgery, there have been many attempts to simplify the task of driving a needle carrying suture through body tissues to approximate, ligate and fixate them. Many prior disclosures, such as described in U.S. Pat. No. 919,138 to Drake et al., employs a hollow needle driven through the tissue with the suture material passing through the hollow center lumen. The needle is withdrawn, leaving the suture material in place, and the suture is tied, completing the approximation. A limitation of these types of devices is that they are particularly adapted for use in open surgical procedures where there is ample room for the surgeon to manipulate the instrument.

Others have attempted to devise suturing instruments that resemble traditional forceps, such as U.S. Pat. No. 3,946,740 to Bassett. These devices pinch tissue between opposing jaws and pass a needle from one jaw through the tissue to the other jaw. Graspers then pull the needle and suture material through the tissue. A limitation of these designs is that they also are adapted primarily for open surgery, in that they require exposure of the tissues to be sutured in order that the tissue may be grasped or pinched between the jaws of the instrument. This is a severe limitation in the case of endoscopic surgery.

Less invasive arthroscopic techniques are beginning to be developed in an effort to address the shortcomings of open surgical repair. Access to the operative site using endosurgical or minimally invasive techniques is accomplished by inserting small tubes, known as trocars, into a body cavity. These trocars have a diameter of, for example, between 3 mm and 30 mm and a length of about 150 mm (6 inches). Working through small trocar portals that minimize disruption of the deltoid muscle, surgeons have been able to reattach the rotator cuff using various bone anchor and suture configurations. The rotator cuff is sutured intracorporeally using instruments and techniques such as those previously described. The repair is completed by tying the cuff down against bone using the anchor and suture that is knotted to secure the tissue in proximity to the bone.

The suture knots in the tissue can be bulky and create a painful impingement of the tendon on the bone. This is because the knots end up on top of the cuff, in the subacromial space, and have the opportunity to rub on the acromion as the arm is raised. Because non-absorbable suture materials are used for these types of repairs, the suture and associated knots are not absorbed into the body, and hence provide a constant, painful reminder of their presence. Accordingly, devices configured to place, retrieve, and secure sutures in tissue without reliance on tying knots are desirable. Additionally, devices configured to grasp and secure tissue to effect the placement of suture in a particular location of the tissue provide an advantageous utility that is valued by practitioners during the practice of endoscopic tissue repair.

SUMMARY

The present device and methods include an instrument that combines the function of both grasping the tissue and passing sutures through the tissue to form a stitch. In a general sense, the instrument includes a pair of grasping jaws that oppose each other along a line substantially perpendicular to the long axis of the instrument. The distal end of the instrument incorporates the fixed jaw, and proximal to that jaw is a moveable jaw that is controlled by the user via a lever on the handgrip.

In a preferred embodiment the instrument is inserted through a portal known as a trocar cannula. The portal is created by first making an incision in the skin, and then inserting a cannula through the incision to the repair site. The distal end of the instrument is inserted through the cannula under direct visualization from a second trocar cannula that has been previously inserted. The visualization is accomplished via an endoscope, of a type well known in the art. The instrument is inserted until the jaws reach, for example, torn rotator cuff tissue. In operation, the distal end of the grasper aspect of the instrument is positioned at the repair site underneath the tissue to be grasped. The moveable jaw is movable toward the stationary jaw by squeezing the handle lever. The handle lever moves inward by pivoting about a pivot pin.

Once the surgeon is satisfied with the placement of the grasper on the grasped tissue, the surgeon can then deploy a suture needle to create a stitch in the tissue, for example, the above-mentioned torn rotator cuff. In operation, the suture needle may be advanced through the grasped tissues by actuating a second lever. In order to create the suture, at least one needle advances to engage a suture disposed in the stationary jaw. The needle comprises a distal point, a proximal shaft, and a hook defining a suture holding area. The suture needle is actuated such that the tip of the suture needle engages a portion of suture housed in a more distal portion of the stationary jaw, and begins to penetrate through the bottom of the grasped tissue and advances upward toward the movable jaw. Thereby, the device includes features to allow the needle engage and capture the suture and then to penetrate tissue and draw the suture through the tissue.

The movable jaw may incorporate a suture capture member disposed at a distal end of the device. In certain embodiments, the suture capture member may comprise a cartridge removably disposed on one of the jaws at the distal end of the distal. The suture capture member may be characterized by apertures coaxial to the longitudinal axis of the suturing device designed to allow the suture needle engaged with suture to pass therethrough. The suture capture member comprises components designed to spring away from the aperture in order to allow passage of the suture needle and suture through the aperture on the upstroke of the needle through the tissue. The aperture may be further characterized by opposed serrated edges, fingers or teeth to assist in securing the portion of suture as the needle begins a down stroke through the aperture and the tissue.

The instrument can be retracted back through the portal via the trocar cannula. As the instrument is removed from the suture site, the free ends of the suture are retrieved as well. This causes the suture form a looped stitch in the tissue.

Thus, the disclosed embodiments comprise a combination of features and characteristics which are directed to allow it to overcome various shortcomings of prior devices. The various characteristics described above, as well as other features, will be readily apparent to those skilled in the art upon reading the following detailed description of the preferred embodiments of the invention, and by referring to the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** illustrates a perspective view of a suturing device in accordance with at least some embodiments.

FIG. **2**A illustrates a perspective view of a suture capture member in accordance with at least some embodiments.

FIG. **2**B illustrates a cross-sectional view of the suture capture member in accordance with at least some embodiments.

FIG. **3** illustrates a perspective view of a suture capture cartridge in accordance with at least some embodiments.

FIG. **4**A illustrates a perspective view of a suturing device in accordance with at least some embodiments.

FIG. **4**B illustrates a perspective view of a suturing device in accordance with at least some embodiments.

FIG. **4**C illustrates a perspective view of a suturing device in accordance with at least some embodiments.

FIG. **4**D illustrates a perspective view of a suturing device in accordance with at least some embodiments.

DETAILED DESCRIPTION

The present invention relates to a method and apparatus for suturing of soft tissue at a surgical repair site. In one variation the invention uses a device that is a combination tissue grasper and suture placement device. Although the present invention is described primarily in conjunction with the repair of a torn rotator cuff, the apparatus and method could also be used in arthroscopic repair at other sites, such as the knee, elbow, hip surgery, and for other surgical techniques for securing suture in the soft tissues of the body.

One embodiment of a suture passer instrument having a suture capture mechanism is shown in the perspective view of FIG. **1**. Suturing device **100** includes lower jaw member **102** and upper jaw member **104** disposed at a distal end of the device. Jaws **102** and **104** are connected to an elongate housing **108** comprising a hollow tube. In certain embodiments, upper jaw **104** may be further characterized by opening **105** at the distal end of device **100**. Lower jaw **102** may have a suture recess **106** oriented in a generally perpendicular direction to the longitudinal axis of device **100** for engaging and accommodating a length of suture **300** with free ends **320**, **330** in preparation for stitching the length of suture **300** through the soft tissue and subsequently capturing the length of suture **300**. The distal portion of device **100** between jaws **102**, **104** defines a tissue receiving area **150**.

In certain embodiments, upper jaw **104** includes suture capture member **200** disposed at the distal end of device **100**. Suture capture member **200** may in some embodiments comprise a suture capture cartridge **201** removably disposed within opening **105** of upper jaw **104**. Referring now to FIGS. **2**A and **3**, suture capture member **200** comprises elongate aperture **202** formed by edges **204**, **206** on each opposed side. Edges **204**, **206** may further comprise suture capture surface **208** in certain embodiments. Suture capture surface **208** may be configured as opposed serrated edges, a plurality of interdigitating teeth, a plurality of opposed notches, or other similar opposed edge features. Suture capture cartridge **200** further comprises deflecting portions **210**, **212** (i.e., arms **210**, **212**) which extend from edges **204**, **206** respectively, and may be formed in a curved or arcuate shape. Referring now to FIG. **2**B, suture capture member **200** is disposed relative to upper jaw **104** such that gaps **214**, **216** are created between arms **210**, **212** and the respective inner surfaces within upper jaw **104**. In certain embodiments, cartridge **201** and/or the components of suture capture member **200** are preferably comprised of high temper spring steel material.

Suturing device **100** is inserted through a trocar cannula until jaws **102**, **104** reach the tissue to be treated. Upper jaw **104** may be actuated into the open configuration and soft tissue **400** is introduced into the space between the upper jaw **104** and the lower jaw **102**. Referring now to FIG. **4**A, by means of a mechanism not discussed or shown herein, but of a type well known to those skilled in the art, the upper jaw **104** is movable relative to lower jaw **102**, causing upper jaw **104** to clamp or grasp the soft tissue **400** and immobilize it between the upper jaw **104** and the lower jaw **102**. In certain embodiments, upper jaw **104** may be pivoted about a generally perpendicular axis relative to housing **108**, or alternatively the connection between lower jaw **102** and upper jaw **104** may be a reciprocating or cam system wherein upper jaw **104** is movable relative to lower jaw **102**. With upper jaw **104** positioned in proximity to lower jaw **102**, jaws **102**, **104** are thereby positioned in the closed configuration.

In certain embodiments, lower jaw **102** is stationary while upper jaw **104** is movable relative to lower jaw **102** or pivotable about a fixed point coupled to the distal end of housing **108**. The movable nature of upper jaw **104** allows jaws **102**, **104** to be actuated between an open configuration for receiving tissue and a closed configuration for grasping tissue. Referring now to FIG. **4**B, suture needle **110** is movably disposed within housing **108**, and comprises shaft **112**, point **114**, and suture capture area **116**. Needle **110** is axially movable within and extendable from housing **108**, such that needle point **114** may be positioned in a retracted position withdrawn from tissue receiving area **150** or in an extended position displaced through upper jaw **104**. According to the embodiments described herein, needle **110** is configured such that it is generally directable upward from its retracted position away from tissue receiving area **150** to its extended position displaced through upper jaw **104** and soft tissue **400**. For example, it is contemplated that needle **110** may be ramped generally upward off a surface in lower jaw **102** as it is displaced from the retracted position to the extended position. In certain embodiments, needle **110** is comprised of a super-elastic material such as nitinol, has a generally circular cross-section, and is preformed to include a bend or curved region **118** at the distal end portion of needle **110**. The super-elastic nature of the material comprising needle **110** in these embodiments allows that needle **110** may be disposed in a generally linear configuration while placed in the retracted position, and then returns to the preformed curved configuration during the displacement of needle **110** from the retracted to extended position.

The housing **108** is coupled to a handle portion (not shown) having a similar or the same design as those typically used in conventional suturing devices as discussed above. For example, such a handle portion in accordance with the embodiments discussed herein may have a stationary grip with a moveable needle deployment lever to actuate axial movement of the needle. The handle portions further include

a deployment member or trigger to effectuate closing of the jaws **102**, **104** to grasp and secure the tissue therebetween.

With the position of the soft tissue **400** grasped between jaws **102**, **104** and within the tissue receiving area **150** device **100** deemed satisfactory, needle **110** may be deployed by actuation of needle deployment member or trigger in the handle portion of device **100** to the extended position, as depicted in FIG. **4**B. Needle **110** is advanced axially toward the distal end of device **100** such that suture capture area **116** engages suture **300** accommodated in suture recess **106** of lower jaw **102** (as previously described and depicted in FIG. **1**). As described above, in certain embodiments needle **110** comprises a super-elastic material and is preformed to include a bend or curved region **118**. The preformed curved region **118** of needle **110** allows that as needle **110** is advanced in a generally distal direction needle point **114** is urged toward upper jaw **104** and needle point **114** thereby penetrates and enters the underside of soft tissue **400** grasped between jaws **102**, **104**. In addition to needle point **114** penetrating and entering soft tissue **400**, the advancement of needle **110** also results in passing suture capture area **116** and the length of suture **300** engaged within suture capture area **116** through soft tissue **400**. The tissue receiving area **150** may be defined by protrusions or teeth **103** to assist in retaining the tissue within the tissue receiving area **150** as needle **110** advances through the soft tissue **400**.

With needle point **114**, suture capture area **116**, and suture **300** drawn through soft tissue **400**, the actuation of needle **110** continues until needle **110** advances into and through opening **105** in upper jaw **104**. Concurrently, needle **110** and length of suture **300** are also directed through aperture **202** of suture capture member **200**. Referring concurrently to FIGS. **2**B and **4**, as needle **110** passes through aperture **202**, needle **110** contacts edges **204**, **206** such that each of arms **210**, **212** are deflected away from needle **110** and into a portion of gaps **214**, **216**. The deflection of arms **210**, **212** is designed to be elastic such that arms **210**, **212** respectively return to or spring back into a pre-deflected position upon the subsequent withdrawal of needle **110** through aperture **202**. In the fully extended position of needle **110**, the length of suture **300** that has been drawn through soft tissue **400** forms a suture portion **310** which protrudes from and is disposed above upper jaw **104** and suture capture member **200**. In certain embodiments, suture portion **310** may form a looped configuration.

With the suture portion **310** protruding through suture capture member **200**, needle **110** may be withdrawn through aperture **202** and returned to a retracted position, as depicted in FIG. **4**C. As needle **110** is withdrawn through suture capture member **200**, arms **210**, **212** spring back to a non-deflected position such that aperture **202** and suture capture surface **208** are allowed to close around suture portion **310** of suture **300**. Aperture **202** is large enough and the spring deflection of arms **210**, **212** is great enough that these characteristics of suture capture member **200** do not restrict the movement of needle **110** during displacement to the extended position. However, arms **210**, **212** are configured such that arms **210**, **212** can only be deflected in an outward direction, away from the top outer surface of upper jaw **104**, as needle **110** is moved through aperture **202** during displacement to the extended position. In addition, aperture **202** is sufficiently small when arms **210**, **212** are in the non-deflected configuration so that suture portion **310** is not allowed to pass back through suture capture member **200**. Further, suture capture surface **208** engages and captures suture portion **310**, and further secures suture portion **310** of suture **300** as needle **110** is withdrawn through aperture **202** and returned to the retracted position. Thereby, suture portion **310** is trapped in suture capture member **200** on upper jaw **104** with a portion of suture **300** simultaneously stitched through soft tissue **400**. Thereafter, jaws **102**, **104** of device **100** are opened to release soft tissue **400** from the grasp of device **100**.

Referring now to FIG. **4**D, with jaws **102**, **104** of device **100** fully actuated into the open configuration and needle **110** displaced to the fully retracted position (not shown), device **100** is pulled away from the repair site and retracted through the trocar cannula, thereby leaving a portion of suture **300** stitched through a portion of soft tissue **400**. Concurrently, suture portion **310** of suture **300** may be pulled away from the repair site and withdrawn from the trocar cannula. Suture portion **310** is manually removed from suture capture member **200** creating suture free ends **320**, **330** that may be utilized to secure soft tissue **400** to a desired location using soft tissue attachment methods or bone anchors otherwise known in the art.

While preferred embodiments of this invention have been shown and described, modifications thereof can be made by one skilled in the art without departing from the scope or teaching herein. The embodiments described herein are exemplary only and are not limiting. Because many varying and different embodiments may be made within the scope of the present teachings, including equivalent structures or materials hereafter thought of, and because many modifications may be made in the embodiments herein detailed in accordance with the descriptive requirements of the law, it is to be understood that the details herein are to be interpreted as illustrative and not in a limiting sense.

What is claimed is:

1. A suturing device for use endoscopically, comprising:

a first and second jaw member, the first and second jaw members being disposed at a distal end of the device;

a housing disposed between a handle and the first and second jaw members;

a needle disposed in the housing while in a retracted position and movable between the retracted position and an extended position, wherein the needle is operable to engage a length of suture; and

a suture capture member disposed on one of the first and second jaw members, wherein the suture capture member comprises an aperture coaxial with a longitudinal axis of the suturing device, the aperture defined by first and second arms wherein at least one arm has a serrated suture capture surface spaced away from a suture capture surface of the other arm so as to define the aperture, and wherein the first and second arms are operable to be elastically deflected outward by the needle when in the extended position, and such that a portion of the length of suture is captured within the aperture upon the needle being returned to the retracted position and the first and second arms returning to a non-deflected position;

wherein the first and second arms further comprise a distally disposed channel that engages a distal end of one of the first and second jaw members, the channel further defining an elongate gap between a surface of one of the first and second jaw members and an outer surface of the first and second arm, the first and second arms being operable to the elastically deflected outward into the elongate gap by the needle when in the extended position.

2. The device of claim **1**, wherein the first and second jaw members are actuatable between an open configuration and a closed configuration.

3. The device of claim **1**, further comprising a suture recess disposed proximate the first and second jaw members,

wherein the suture recess is configured to engage the length of suture while the needle is in the retracted position.

4. The device of claim **1**, wherein both of the suture capture surfaces comprise a serrated edge.

5. The device of claim **1**, wherein the needle comprises a preformed curved region in a distal needle region, wherein the distal needle region is bent so as to be generally linearly when the needle is disposed in the retracted position and the preformed curved region is released when in the extended position.

6. The device of claim **5**, wherein the needle comprises nitinol.

7. The device of claim **1**, wherein the suture capture member comprises high temper spring steel.

8. The device of claim **1**, wherein moving the needle between the retracted position and the extended position further comprises displacing the needle through a tissue receiving area.

9. The device of claim **1**, wherein the suture capture member comprises a suture capture cartridge removably disposed on one of the first and second jaw members.

10. The device of claim **1**, wherein the coaxial aperture is centrally disposed between the first and second arms.

11. The device of claim **1**, wherein the coaxial aperture extends up to and including a distal end of the suture capture member.

12. The device of claim **1**, wherein the suture capture member is disposed on the second jaw and wherein the coaxial aperture of the suture capture member extends further distally than the first jaw.

13. A suturing device for use endoscopically, comprising:

a first jaw member;

a second jaw member, wherein the first and second jaw members are disposed at a distal end of the device, and wherein the second jaw member is movable between an open configuration and a closed configuration;

a suturing needle disposed in a housing, wherein the suturing needle is operable to engage a length of suture;

a suture capture member disposed in the second jaw member, wherein the suture capture member comprises an aperture coaxial with a longitudinal axis of the suturing device, the aperture defined by first and second deflectable portions, and wherein the first and second deflectable portions comprise first and second suture engaging surfaces, at least one of the suture engaging surfaces including serrations, the surfaces spaced away from each other to define the aperture; the combination of the aperture and serrations sized to capture a portion of the length of suture and prevent the portion from disengaging the suture capture member;

wherein the suturing needle is movable within the housing and through the aperture in the suture capture member; and

wherein the first and second deflectable portions further comprise a distally disposed channel that engage a distal end of the second jaw member, the channel further defining an elongate gap between an inner surface of the second jaw member and an outer surface of the first and second deflectable portion, the first and second deflectable portions being operable to be elastically deflectable outward into the elongate gap by the needle when the needle is disposed through the aperture.

14. The device of claim **13**, wherein the first jaw member comprises a suture recess portion engageable with the length of suture.

15. The device of claim **13**, further comprising a tissue receiving area defined between the first jaw member and the second jaw member.

16. The device of claim **13**, wherein the needle comprises nitinol.

17. The device of claim **13**, wherein the suture capture cartridge comprises high temper spring steel.

18. The device of claim **13**, wherein the needle is movable between a retracted position and an extended position.

19. The device of claim **13**, wherein the suturing needle comprises a preformed curved region that is elastically stressed so as to become generally linear when disposed within the housing.

20. The device of claim **13**, wherein the second jaw member extends distally farther than the first jaw member and wherein the second jaw member further comprises an opening.

21. The device of claim **20**, wherein the suture capture member comprises a suture capture cartridge removably disposed in the opening and wherein the opening extends farther distally than the first jaw member.

22. A suturing device for deploying a length of suture, the suturing device comprising:

an elongate housing characterized by a longitudinal axis;

a tissue receiving area disposed at a distal end of the housing, wherein the tissue receiving area is defined between a first jaw member and a second jaw member;

a suture recess disposed within the tissue receiving area, wherein the suture recess is operable to engage a length of suture;

a suture capture member disposed in the second jaw member, wherein the suture capture member comprises a first and second deflecting portion, each deflecting portion further comprising a distally disposed channel that engages a distal end of the second jaw, the channel further defining a first and second elongate gap between an inner surface of the second jaw member and an outer surface of the deflecting portion,

a needle disposed within the housing, wherein the needle is movable through the tissue receiving area, and wherein the needle comprises a suture holding area, the suture holding area operable to engage the length of suture; and

wherein the needle is configured to pass through an elongate aperture coaxial with the longitudinal axis, the aperture disposed in the suture capture member and extends up to and including a distal end of the suture capture member, the suture capture member disposed farther distally than the first jaw member, and wherein the first and second deflecting portion of the suture capture member are elastically deflected into the first and second gap to allow passage of the needle, and wherein the length of suture captured in the suture holding area is positioned to protrude away from the suture capture member in a looped configuration and is fixedly secured between the deflecting portion upon return of the first and second deflecting portion to a non-deflected position.

23. The device of claim **22**, wherein the second jaw member is actuatable between an open configuration and a closed configuration.

24. The device of claim **22**, wherein the needle comprises nitinol.

25. The device of claim **24**, wherein the needle comprises a preformed curved region that is elastically bent to become generally straight while disposed in the housing.

26. The device of claim **22**, wherein the deflecting portion further comprises a suture capture surface.

27. The device of claim 26, wherein the suture capture surface comprises a serrated edge.

28. The device of claim 22, wherein the suture capture member comprises high temper spring steel.

29. The device of claim 22, wherein the second jaw member comprises an opening.

30. The device of claim 29, wherein the suture capture member comprises a suture capture cartridge removably disposed in the opening.

31. A suturing device for grasping tissue and deploying a length of suture into the tissue, the suturing device comprising:

an elongate housing;

a stationary jaw member, wherein the stationary jaw member comprises a suture recess engageable with the length of suture;

a movable jaw member, wherein the movable jaw member is pivotably coupled with the elongate housing, the movable jaw member actuatable between an open configuration and a closed configuration;

a tissue receiving area defined between the stationary jaw member and the movable jaw member;

a needle disposed in the housing, the needle comprising a preformed curved region that is elastically bent so as to become generally linear while disposed in the housing, wherein the needle is extendable and retractable through the tissue receiving area, and wherein the needle comprises a suture holding area operable to engage the length of suture; and

a suture capture member disposed in the movable jaw member, wherein the suture capture member comprises an elongate aperture coaxial with a long axis of the housing, and wherein a portion of the aperture extends distally relative to the stationary jaw member, wherein the needle and the length of suture are extendable through a deflecting portion of the aperture, and wherein the suture capture member further comprises a distally disposed channel that engages a distal end of the movable jaw member, the channel further defining an elongate gap between an inner surface of the movable jaw member and an outer surface of the suture capture member, the deflecting portion of the aperture being operable to be elastically deflected outward into the elongate gap when the needle is extended into the deflecting portion of the aperture

and wherein the aperture is sized to prevent a portion of the length of suture from passing back through the suture capture member upon return of the deflecting portion to a non-deflected position.

32. The device of claim 31, wherein the needle comprises nitinol.

33. The device of claim 31, wherein the suture capture cartridge comprises high temper spring steel.

34. The device of claim 31, wherein the aperture comprises a plurality of interdigitating teeth disposed to prevent distal disengagement of the suture.

35. The device of claim 34, wherein the aperture comprises a serrated edge.

36. The device of claim 31, wherein the movable jaw member comprises an opening up to and including a portion of a distal tip of the movable jaw.

37. The device of claim 36, wherein the suture capture member comprises a suture capture cartridge removably disposed in the opening.

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